Materials Engineering Branch

TIP*

No. 045 Examination of Failed Spacecraft Hardware

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No matter how careful the designer and fabricator are, failures of spacecraft hardware are bound to occur prior to launch. Fortunately, such failures are capable of being examined and analyzed to determine why and how they failed and the results of the examination can be used to prevent repeat failures. This is only true, of course, if the failure analyst has a suitable sample to analyze.

However, what happens in many cases is that persons who are not trained or equipped to perform the examination either make an initial assessment or else "clean up" the failure for the analyst. More often than not, in so doing, the non-analyst actually removes or obliterates useful evidence and thus makes the task of the analyst more difficult if not impossible. Washing, sand blasting, or otherwise removing adhering debris or reaction products may make the failed hardware look good, but it may also render the failure non-analyzable.

Especially in the examination of failed miniature parts, for example, electronic device leads, small bearings, etc., often the evidence that is being sought is almost microscopic in size and quantity. Even undue handling can cause a loss of useful evidence in some cases. In particular, fracture surfaces should not be put back together as even incidental contact can alter the crack morphology.

Therefore, it is recommended and strongly urged that failed components be turned over intact to the person or persons who will perform the failure analysis. If the failure is remote from the laboratory, it should be packaged carefully in clean Teflon or polyethylene bags or other non-contaminating and protective containers, and transported to the laboratory personnel for examination. Alternately, MEB personnel can be contacted to assist in the collection of suitable samples for evaluation.

Although this TIP primarily relates to metal failures, the guidance provided is also applicable to other materials failures.